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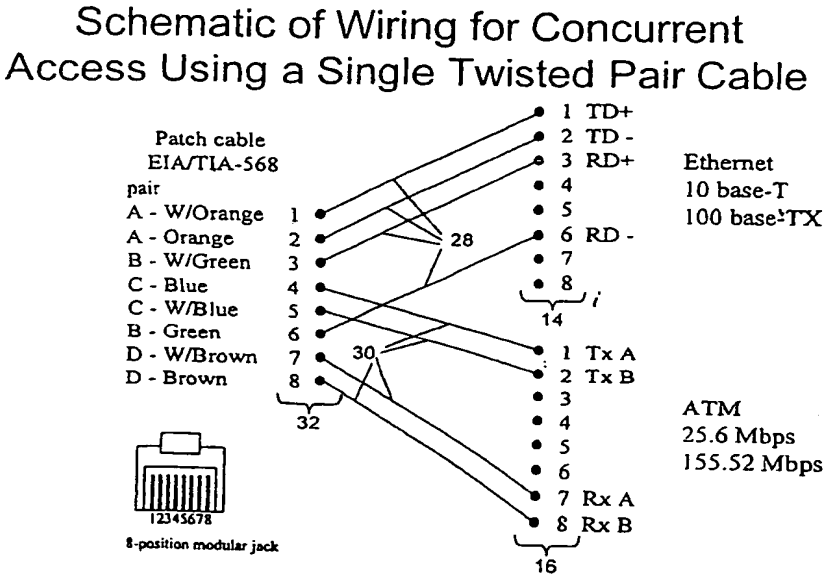
(54) Title: METHODS AND APPARATUS FOR CONCURRENT ACCESS TO MULTIPLE NETWORKS



(57) Abstract: Apparatus and methods to provide concurrent access to multiple netorks (e.g., Internet and ATM networks) by using a single twisted pair cable. Connectors according to the invention map the wiring for accessing multiple switches (e.g., an Ethernet switch and an ATM switch) into the same twisted pair cable.

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METHODS AND APPARATUS FOR CONCURRENT ACCESS TO MULTIPLE NETWORKS

This application claims benefit of copending and commonly owned U.S. Provisional Application No. 60/136,214, filed May 26, 1999, entitled "Concurrent Access to Internet and Atm Networks Using Twisted Pair Cable," which is incorporated herein by reference.

Background of the Invention

The present invention pertains to network communications, and particularly to wiring and connector technologies for facilitating access to Internet, ATM, and other networks.

A PC, workstation, or other intelligent appliance is often connected to a network for the exchange of information, frequently by a cable containing multiple conductors, such as a twisted-pair cable (*e.g.*, UTP category 5 cable). Signal sets which are commonly carried over such cables include those compatible with ethernet, Asynchronous Transfer Mode (ATM) and other network link layer protocols.

Laying cable through an office or home environment to create a network is both expensive and disruptive. When changing an entire system from an Ethernet network to an ATM network (or vice versa), existing cables can sometimes be reused to avoid this procedure. However, existing cabling infrastructure cannot generally be used for *concurrently* carrying signal sets compatible with multiple network protocols. For example, IP-based and ATM-based signal sets cannot normally be carried over the same cable, because these signal sets are conventionally carried on overlapping sets of conductors. If it is desired to access the Internet, via ethernet, and ATM networks simultaneously (or other combinations of networks), multiple cables must be used.

An object of this invention is to provide improved wiring and connector apparatus and methods for network communications.

A further object is to provide such apparatus and methods as facilitate carrying multiple network signal sets with minimal capital outlay.

Still yet a further object of this invention is to provide such apparatus and methods as permit the transfer of multiple network signal sets in a manner compatible with existing communications equipment.

Summary of the Invention

The present invention addresses the foregoing needs by providing concurrent access to multiple network signal sets (*e.g.*, for Ethernet and ATM networks) using a single twisted pair cable. This is achieved by mapping the signals into non-overlapping conductor sets within the same twisted pair cable.

In one aspect, the invention provides a cable system for carrying at least two signal sets that normally use overlapping sets of conductors. The system includes four connectors coupled to a common cable, two for each signal set. The connectors have pins carrying the signal sets, which are connected to nonoverlapping sets of conductors in the common cable. The conductors of the common cable may share a common sheath, as in a typical twisted pair cable such as UTP category 3 or category 5 cable.

In one configuration according to the invention, the system is designed to provide concurrent access to IP and ATM networks by carrying Ethernet signal sets and ATM signal sets over a single common cable. The system includes four connectors and a common cable. Two of the four connectors have pins that carry the Ethernet signal set and are coupled to a first set of conductors of the cable, and the other two of the connectors have pins that carry the ATM signal set and are coupled to a second set of conductors of the cable. The two sets of conductors are nonoverlapping; that is, they have no conductors in common.

The invention further provides connectors for coupling to a cable according to similar schemes. Each such connector comprises two connections: one for coupling pins carrying each signal set to conductors in the cable, where the normal pins for carrying the signal sets overlap, but the connector couples them to nonoverlapping sets of conductors in the cable. The connections may take a variety of physical forms, such as jacks, sockets, patch cords, cables, and other connectors.

In addition, the invention comprises a kit for connecting two or more intelligent appliances to multiple networks, where the kit includes two or more connectors of the type described above.

The foregoing has outlined some of the more pertinent aspects of the present invention. These aspects should be construed to be merely illustrative of some of the more prominent features and applications of the invention. Many other beneficial results can be attained by applying the disclosed invention in a different manner or modifying the invention as will be described. Accordingly, other aspects and a fuller understanding of the invention may be had by referring to the following Detailed Description.

Brief Description of the Drawing

The invention is described with reference to the several figures of the drawing, in which,

Figure 1 depicts the typical configuration of connecting a PC to two network access points using two separate twisted pair cables;

Figure 2 shows the wiring diagram for connecting a PC to an Ethernet switch or hub using twisted pair cable;

Figure 3 depicts the wiring diagram for connecting a PC to an ATM switch using twisted pair cable;

Figure 4 shows the preferred embodiment of a PC with concurrent access to an Ethernet switch or hub and an ATM switch using a single twisted pair cable; and

Figure 5 depicts the preferred embodiment of the wiring diagram for concurrent access of an Ethernet switch or hub and an ATM switch.

Detailed Description

This invention provides apparatus and methods of local access that allow the concurrent access to two or more network services (e.g., IP and ATM) using a single twisted pair cable. It can be used for connecting any type of electronic device (intelligent appliance), including, but not limited to, desk-top personal computers, laptops, digital telephones, digital televisions, and video-conferencing equipment, to the Internet or to ATM networks. For the sake of brevity, however, the invention will be described in the context of a networked desktop computer system only, with reference to a combination of IP and ATM based networks, using UTP category 5 cable, and 10/100Base-TX and ATM-25/155 UTP cabling schemes. It is easily understood that any combination of the above can be used for concurrent access to two or more networks of the same or different types.

Figure 1 shows a representative embodiment of a PC that includes network connections for interfacing with the Internet and/or ATM network. The PC also includes display screen **20** for displaying information to the user, keyboard **22** for inputting text and user commands, mouse **24** for positioning a cursor on display screen and inputting user commands, and disk drive **26** for reading from and writing to floppy disks installed therein. The PC may also have one or more peripheral devices (not shown) attached thereto for inputting text, graphics images, or the like, and a printer attached thereto for outputting images.

When using twisted pair technologies, local access to the Internet or an IP network via an Ethernet **14** hub or switch or XDSL modem is realized with a wiring scheme as depicted in **Figure 2**. Typical access rates are 10Mb/s or 100 Mb/s but higher rates such as 1 Gb/s are also possible.

ATM local access using twisted pair cable is realized by a wiring scheme as depicted in **Figure 3**. Typical access rates are 25Mb/s and 155 Mb/s are used although other rates are also available.

As evident from **Figures 2** and **3**, concurrent local access to IP and ATM-based networks has not conventionally been thought to be possible using a single twisted pair cable. This is because wire pair A, using wires denoted 1 and 2, is used by both the Ethernet and ATM access to these networks. Systems in accord with the invention overcome this.

In an embodiment of this invention, circuit board pinouts or other connections (e.g., on NICs), jacks, plugs, sockets, patch cords, connectors or other apparatus are utilized to route multiple network signals to non-overlapping conductors in a common cable, e.g., a UTP category 3 or category 5 cable. This facilitates coupling with a single cable PCs or other apparatus, e.g., employees' workstations, to multiple centralized network servers, e.g., residing in an MIS or IT department. Through use of such apparatus, for example, an office wired for Ethernet access can be readily equipped to provide ATM access, as well, without running separate cabling for the additional network.

Figure 4 depicts a system utilizing the invention. In the system, two NICs **10,12** are present: one connects the PC to the Internet and the other to an ATM network. The local access to the Ethernet switch **14** and ATM switch **16**, depicted in **Figure 4**, is based on four wires each **28,30** that are mapped into an eight wire (4 pairs) twisted pair cable **32**. This allows the concurrent access of an intelligent appliance such as a PC or a workstation to IP and ATM-based networks.

The detailed wiring diagram is shown in **Figure 5**. It can be embodied in circuit board pinouts or other connections (e.g., on NICs), jacks, plugs, sockets, patch cords, connectors or other apparatus, e.g., at each end of a common cable. In the preferred embodiment of the invention, wire pairs A (wires 1 and 2) and B (wires 3 and 6) are used for access to IP network services whereas wire pairs C (wires 4 and 5) and D (wires 7 and 8) are used for access to ATM network services. These wire pairs are coupled to the standard pins on external connectors for each of the Ethernet and ATM signal sets. (As used herein, the term "pin" includes any of the many structures known in the art for electrically connecting to a single conductor of a cable).

In a preferred embodiment for use with UTP category 5 cable, wiring within the connector is twisted on a per-pair basis. For example, the wires forming wire pair A must be twisted together, as must those forming each of pairs B, C and D.

Other wiring schemes can also be used as long as two pairs are reserved for access to IP networks and two pairs for access to ATM networks. Furthermore, not only concurrent access to IP and ATM can be accommodated, but also combination of access to two IP-based or two ATM-based access networks. Finally, any application specific pair assignments that uses two pairs, such as 8802-3 (10Base-T), 8802-5 (Token-Ring), FDDI (TP-PMD), ATM 25.6Mbps UTP and ATM 155.52 Mbps UTP, 100Base-TX (802.3u) can be combined together to form concurrent network access.

IP networks provide transport and signaling services as defined by the Internet Engineering Task Force (IETF) whereas ATM networks provide transport and signaling services as defined by the ATM Forum. Concurrent access to ATM and IP services greatly increases the potential of ATM and IP-based networks. This potential can be realized by exploiting the synergies of the two networks. For example, signaling services for controlling ATM switching resources can be supported using the IP networking infrastructure. A case in point is a system whereby signaling information to set ATM Virtual Circuits is transported by IP channels.

The typical embodiment of the invention allows for the following combination of transport: 10 Mb/s Ethernet with 25 Mb/s ATM, and 100 Mb/s Ethernet with 155Mb/s ATM. Other combinations, such as 100 Mb/s Ethernet and 25Mb/s ATM can obviously be accommodated as well. Thus, by way of non-limiting example, the invention can be applied to the transport over a single cable of any combination of signal sets according to the following protocols 8802-3 (10Base-T), 8802-5 (Token-Ring), FDDI (TP-PMD), ATM 25.6Mbps UTP and ATM 155.52 Mbps UTP, and 100Base-TX (802.3u).

As can be seen from **Figure 5**, other wire combinations that result in the same effect of supporting concurrent access to two different networks are possible. The

only requirement is to use one set of cable conductors for the first network access and similarly a different, nonoverlapping set of cable conductors for the second network access.

Other embodiments of the invention will be apparent to those skilled in the art from a consideration of the specification or practice of the invention disclosed herein. Thus, by way of non-limiting example, it will be appreciated that the conductor pair labels, colors and numbers described above are merely examples, and that other combinations can be used instead, in accord with the corresponding standards. It is intended that the specification and examples be considered as exemplary only, with the true scope and spirit of the invention being indicated by the following claims.

What is claimed is:

Claims

1. A cable system for carrying a first signal set that is normally carried over a first set of conductors and a second signal set that is normally carried over a second set of conductors, where the first and second sets of conductors normally have at least one conductor in common, the system comprising

a first connector having pins that carry the first signal set,

a second connector having pins that carry the second signal set,

a third connector having pins that carry the first signal set,

a fourth connector having pins that carry the second signal set, and

a common cable comprising a plurality of conductors, a first set of which are coupled to the pins of the first and third connectors, and a second set of which are coupled to the pins of the second and fourth connectors, where the first and second sets of conductors have no conductors in common.

2. A cable system according to claim 1, wherein the common cable comprises a plurality of conductors surrounded by a common sheath.

3. A cable system according to claim 2, wherein the common cable comprises a single twisted pair cable.

4. A cable system according to claim 3, wherein the common cable comprises any of a UTP category 3 cable, and UTP category 5 cable.

5. A cable system according to claim 4, wherein

the first set of conductors are coupled for signal transmission with the pins of the first and third connectors, and

the second set of conductors are coupled for signal transmission with the pins of the second and fourth connectors.

6. A cable system according to claim 5, wherein the coupling for signal transmission comprises electrical coupling.

7. A cable system for carrying an IP network signal set that is normally carried over a first set of conductors and a ATM network signal set that is normally carried over a second set of conductors, where the first and second sets of conductors normally have at least one conductor in common, the system comprising

a first connector having pins that carry the IP network signal set,

a second connector having pins that carry the ATM network signal set,

a third connector having pins that carry the IP network signal set,

a fourth connector having pins that carry the ATM network signal set, and

a common cable comprising a plurality of conductors, a first set of which are coupled to the pins of the first and third connectors, and a second set of which are coupled to the pins of the second and fourth connectors, where the first and second sets of conductors have no conductors in common.

8. A cable system according to claim 5, wherein

the IP network signal set comprises signals for any of 10 Mb/s Ethernet and 100 Mb/s Ethernet, and

the ATM network signal set comprises signals for any of 25 Mb/s ATM, and 155Mb/s ATM.

9. A cable system according to claim 8, wherein

the IP network signal is normally carried on a conductor set in accord with a 10/100Base-TX cabling scheme, and

the ATM network signal set is normally carried on an ATM-25/155 UTP cabling scheme.

10. A cable system according to claim 9, wherein

the first set of conductors of the common cable comprise a first set of two twisted pairs of conductors, and

the second set of conductors of the common cable comprise a second set of two twisted pairs of conductors,

the first and second sets of two twisted pairs of conductors having no conductors in common.

11. A cable system according to claim 10, wherein

the first set of conductors of the common cable comprise conductor pairs (1, 2) and (3, 6), and

the second set of conductors of the common cable comprise conductor pairs wires (4, 5) and (7, 8).

12. A cable system according to claim 11, wherein

conductor pairs (1, 2) and (3, 6) of the common cable are electrically coupled to same numbered pins of the first connector, and

conductor pairs wires (4, 5) and (7, 8) are electrically coupled to pins (1, 2) and (7, 8), respectively of the second connector.

13. A cable system according to any of claims 7 - 9, wherein the common cable comprises a plurality of conductors surrounded by a common sheath.

14. A cable system according to claim 13, wherein the common cable comprises a single cable of twisted pairs.

15. A cable system according to claim 3, wherein the common cable comprises any of a UTP category 3 cable and UTP category 5 cable.

16. A cable system according to claim 15, wherein

the first set of conductors are coupled for signal transmission with the pins of the first and third connectors, and

the second set of conductors are coupled for signal transmission with the pins of the second and fourth connectors.

17. A cable system according to claim 16, wherein the coupling for signal transmission comprises electrical coupling.

18. A cable system for carrying a first signal set that is normally carried over a first set of conductors and a second signal set that is normally carried over a second set of conductors, where the first and second sets of conductors normally have at least one conductor in common, the system comprising

a first connector having pins that carry the first signal set,

a second connector having pins that carry the second signal set,

a third connector having pins that carry the first signal set,

a fourth connector having pins that carry the second signal set, and

a common cable comprising a plurality of conductors, a first set of which are coupled to the pins of the first and third connectors, and a second set of which are coupled to the pins of the second and fourth connectors, where the first and second sets of conductors have no conductors in common,

the first signal set comprising signals in accord with any of the following standards: 8802-3 (10Base-T), 8802-5 (Token-Ring), FDDI (TP-PMD), ATM 25.6Mbps UTP and ATM 155.52 Mbps UTP, and 100Base-TX (802.3u),

the second signal set comprising signals in accord with any of the following standards: 8802-3 (10Base-T), 8802-5 (Token-Ring), FDDI (TP-PMD), ATM 25.6Mbps UTP and ATM 155.52 Mbps UTP, and 100Base-TX (802.3u).

19. A cable system according to claim 18, wherein the first and second signal sets comprise signals in accord with the same said standard.

20. A cable system according to claim 18, wherein the first and second signal sets comprise signals in accord with different ones of said standards.

21. A cable system according to any of claims 18 - 20, wherein the common cable comprises a plurality of conductors surrounded by a common sheath.

22. A cable system according to claim 21, wherein the common cable comprises a single cable of twisted pairs.

23. A cable system according to claim 22, wherein

the first set of conductors are electrically coupled with the pins of the first and third connectors, and

the second set of conductors are electrically coupled for signal transmission with the pins of the second and fourth connectors.

24. A cable system according to claim 23, wherein

the first set of conductors of the common cable comprise a first set of two twisted pairs of conductors,

the second set of conductors of the common cable comprise a second set of two twisted pairs of conductors,

the first and second sets of two twisted pairs of conductors having no conductors in common.

25. A connector system for adapting a common cable to carry a first signal set that is normally carried over a first set of conductors and a second signal set that is normally carried over a second set of conductors,

where

the first and second sets of conductors normally have at least one conductor in common, and

the common cable comprises a plurality of conductors surrounded by a common sheath,

the connector system comprising

a first connector having pins that carry the first signal set, the pins of the first connector being coupled to a first set of conductors in the common cable, and

a second connector having pins that carry the second signal set, the pins of the second connector being coupled to a second set of conductors in the common cable,

the first and second sets of conductors having no conductors in common.

26. A connector system according to claim 25, wherein

the pins of the first connector are coupled for signal transmission with the first set of conductors of the common cable, and

the pins of the second connector are coupled for signal transmission with the second set of conductors of the common cable.

27. A connector system according to claim 26, wherein the coupling for signal transmission comprises electrical coupling.

28. A connector system for adapting a common cable to carry an IP network signal set that is normally carried over a first set of conductors and a ATM network signal set that is normally carried over a second set of conductors, where

the first and second sets of conductors normally have at least one conductor in common, and

the common cable comprises a plurality of conductors surrounded by a common sheath,

the connector system comprising

a first connector having pins that carry the IP network signal set, the pins of the first connector being coupled to a first set of conductors in the common cable, and

a second connector having pins that carry the ATM network signal set, the pins of the second connector being coupled to a second set of conductors in the common cable,

the first and second sets of conductors having no conductors in common.

29. A connector system according to claim 26, wherein

the IP network signal set comprises signals for any of 10 Mb/s Ethernet and 100 Mb/s Fast Ethernet, and

the ATM network signal set comprises signals for any of ATM 25 Mb/s UTP, and ATM 155Mb/s UTP.

30. A connector system according to claim 29, wherein

the IP network signal is normally carried on a conductor set in accord with a 10/100Base-TX cabling scheme, and

the ATM network signal set is normally carried on an ATM-25/155 UTP cabling scheme.

31. A connector system according to claim 30, wherein

the first set of conductors of the common cable comprise a first set of two twisted pairs of conductors,

the second set of conductors of the common cable comprise a second set of two twisted pairs of conductors,

the first and second sets of two twisted pairs of conductors having no conductors in common.

32. A connector system according to claim 31, wherein

the first set of conductors of the common cable comprise conductor pairs (1, 2) and (3, 6), and

the second set of conductors of the common cable comprise conductor pairs wires (4, 5) and (7, 8).

33. A connector system according to claim 32, wherein

pins (1, 2) and (3, 6) of the first connector are electrically coupled to conductor pairs (1, 2) and (3, 6) of the common cable, and

pins (1, 2) and (7, 8), respectively of the second connector are electrically coupled to conductor pairs wires (4, 5) and (7, 8) of the common cable.

34. A connector system according to any of claims 28 - 30, wherein the common cable comprises a single cable of twisted pairs.

35. A connector system according to claim 34, wherein the common cable comprises any of a UTP category 3 cable and UTP category 5 cable.

36. A connector system according to claim 28, wherein

the first set of conductors are coupled for signal transmission with the pins of the first connector, and

the second set of conductors are coupled for signal transmission with the pins of the second connector.

37. A connector system according to claim 36, wherein the coupling for signal transmission comprises electrical coupling.

38. A connector system for adapting a common cable to carry a first signal set that is normally carried over a first set of conductors and a second signal set that is normally carried over a second set of conductors,

where

the first and second sets of conductors normally have at least one conductor in common, and

the common cable comprises a plurality of conductors surrounded by a common sheath,

the connector comprising

a first connector having pins that carry the first signal set, the pins of the first connector being coupled to a first set of conductors in the common cable, and

a second connector having pins that carry the second signal set, the pins of the second connector being coupled to a second set of conductors in the common cable,

the first and second sets of conductors having no conductors in common,

the first signal set comprising signals in accord with any of the following standards: 8802-3 (10Base-T), 8802-5 (Token-Ring), FDDI (TP-PMD), ATM 25.6Mbps UTP and ATM 155.52 Mbps UTP, and 100Base-TX (802.3u),

the second signal set comprising signals in accord with any of the following standards: 8802-3 (10Base-T), 8802-5 (Token-Ring), FDDI (TP-PMD), ATM 25.6Mbps UTP and ATM 155.52 Mbps UTP, and 100Base-TX (802.3u).

39. A connector system according to claim 38, wherein the first and second signal sets comprise signals in accord with the same said standard.

40. A connector system according to claim 38, wherein the first and second signal sets comprise signals in accord with different ones of said standards.

41. A connector system according to claim 38, wherein the common cable comprises a single cable of twisted pairs.

42. A connector system according to claim 41, wherein

the pins of the first connector are electrically coupled with the first set of conductors of the common cable,

the pins of the second connector are electrically coupled with the second set of conductors of the common cable.

43. A connector system according to claim 42, wherein

the first set of conductors of the common cable comprise a first set of two twisted pairs of conductors,

the second set of conductors of the common cable comprise a second set of two twisted pairs of conductors,

the first and second sets of two twisted pairs of conductors having no conductors in common.

44. A connector system according to any of claims 25, 28 or 38, wherein any of the first and second connectors is embodied in any of a jack, plug, socket, patch cord, cable and connector.

45. A connector kit comprising two or more connector systems according to any of claims 25, 28 or 38.

46. A connector kit according to claim 45, wherein any of the first and second connectors is embodied in any of a jack, plug, socket, patch cord, cable and connector.

47. A method of adapting a common cable to carry a first signal set that is normally carried over a first set of conductors and a second signal set that is normally carried over a second set of conductors,

where

the first and second sets of conductors normally have at least one conductor in common, and

the common cable comprises a plurality of conductors surrounded by a common sheath,

the method comprising

connecting connector systems according to any of claims 25, 28 or 38 to ends of the common cable.

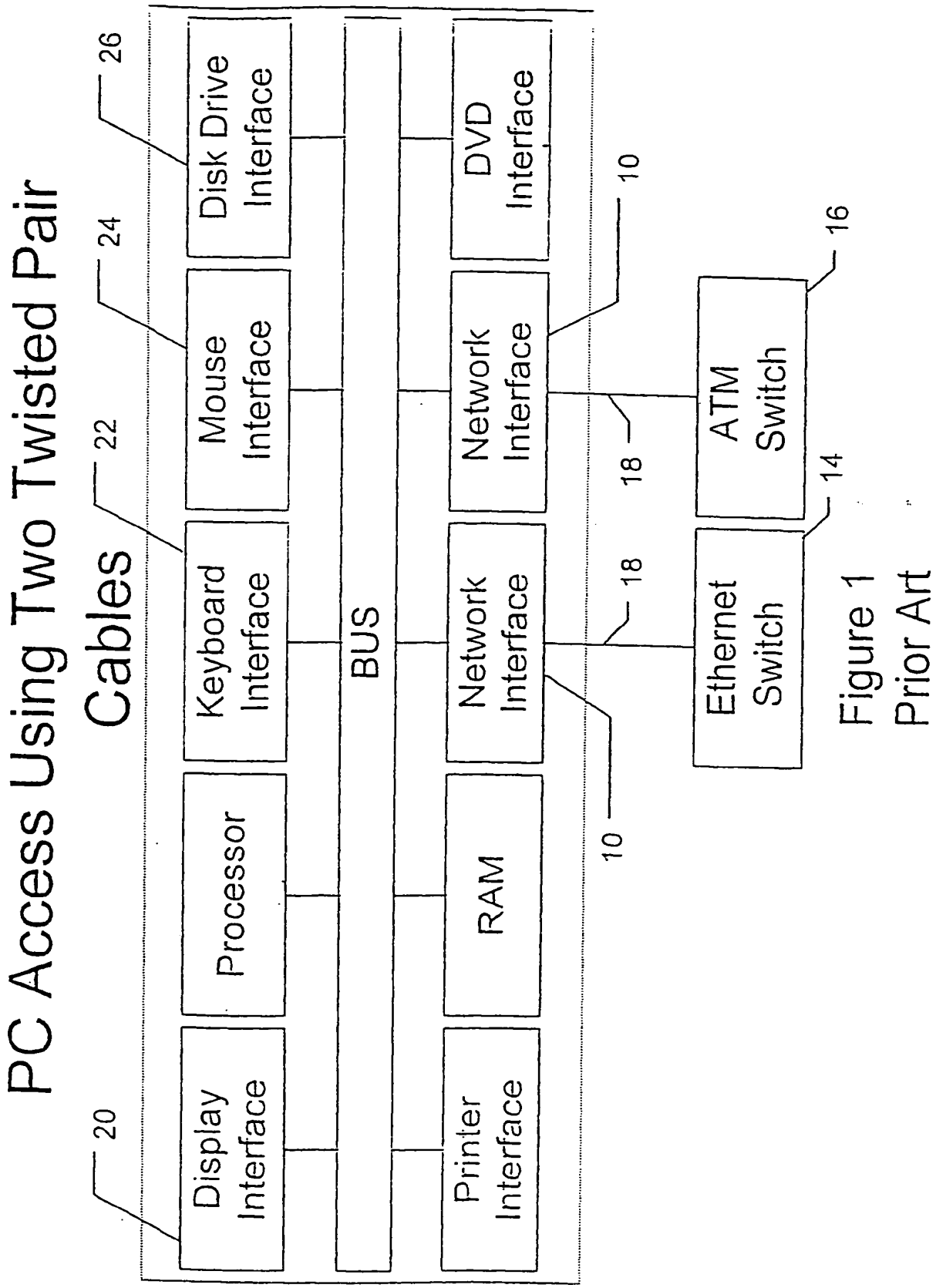
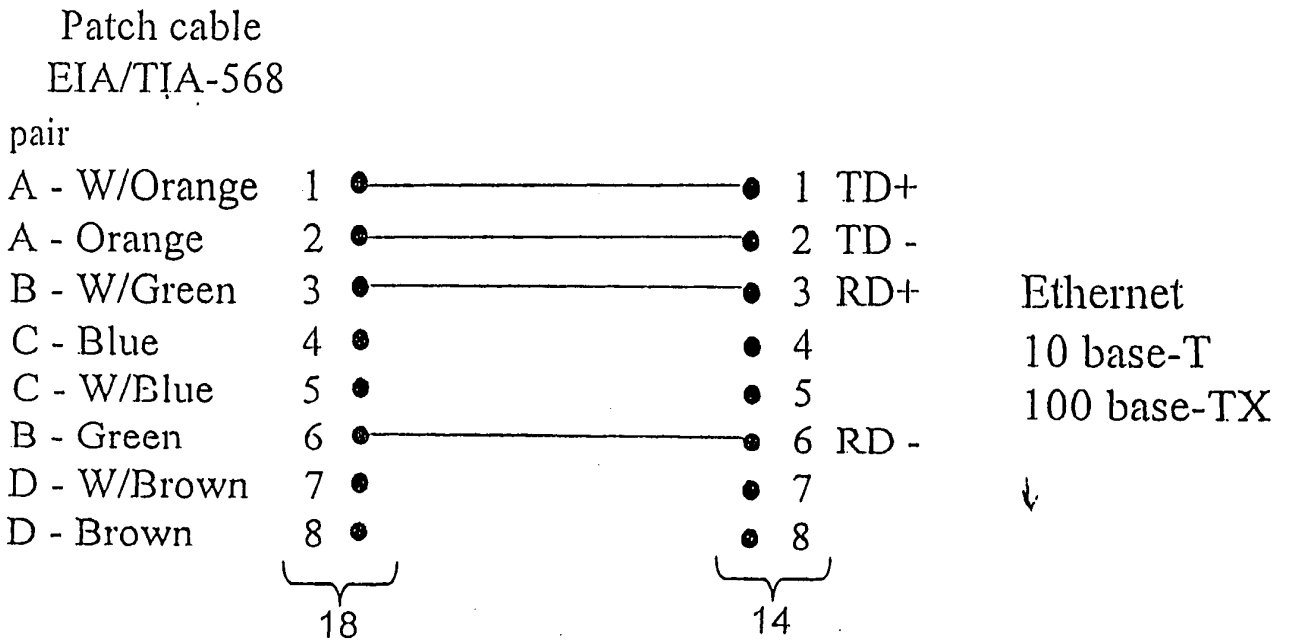
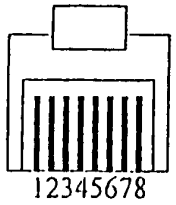


Figure 1
Prior Art

Schematic of Wiring for Ethernet Access

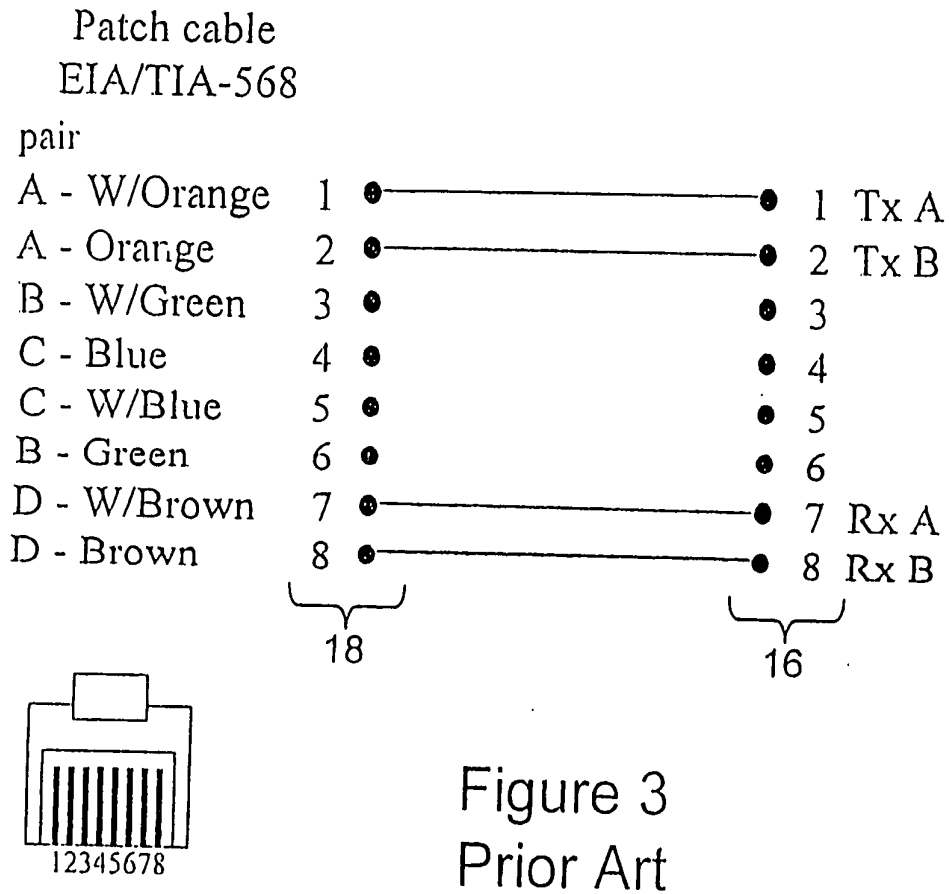




8-position modular jack

Figure 2
Prior Art

Schematic of Wiring for ATM Access



ATM
25.6 Mbps
155.52 Mbps

Figure 3
Prior Art

PC Concurrent Access on a Single Twisted Pair Cable

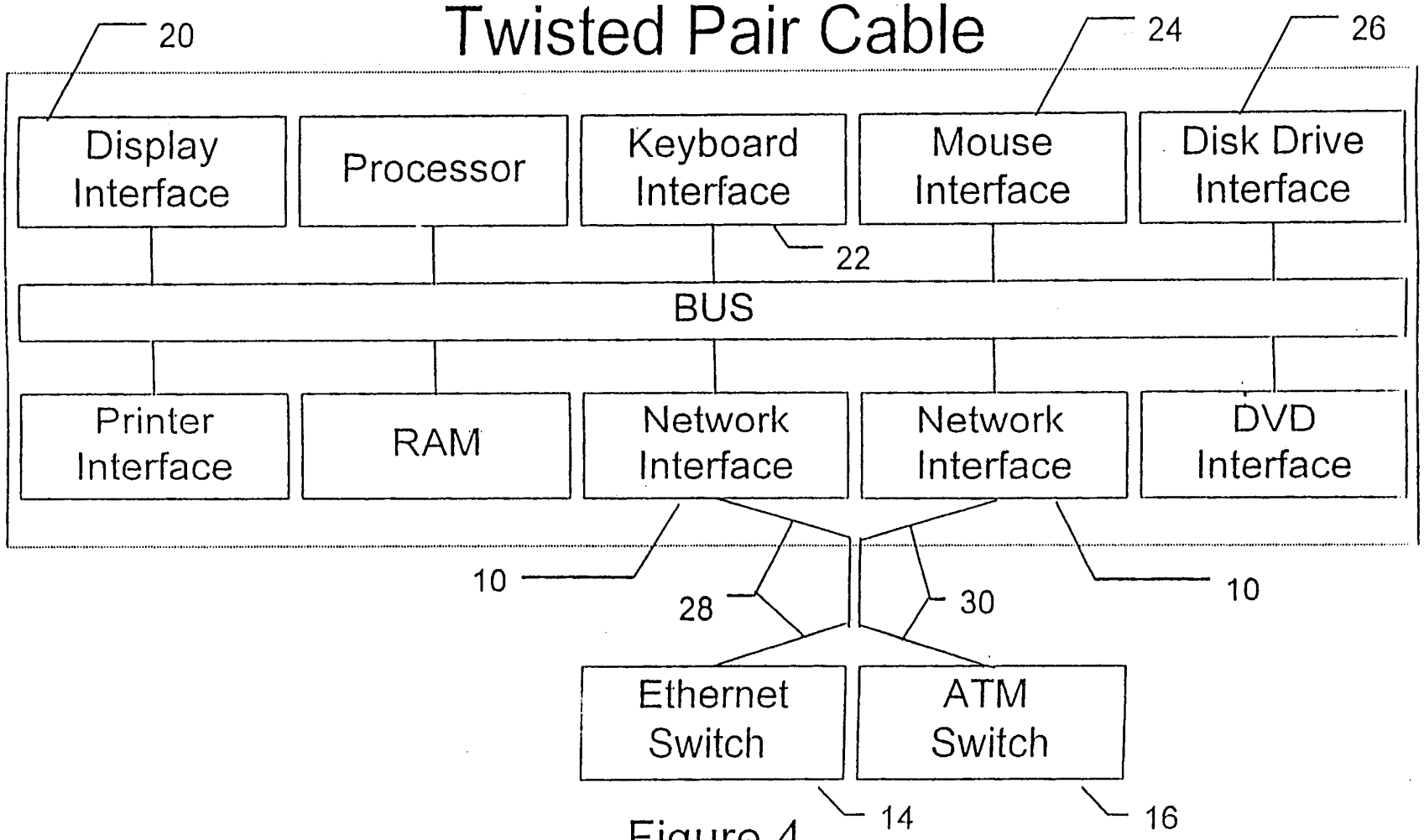


Figure 4

Schematic of Wiring for Concurrent Access Using a Single Twisted Pair Cable

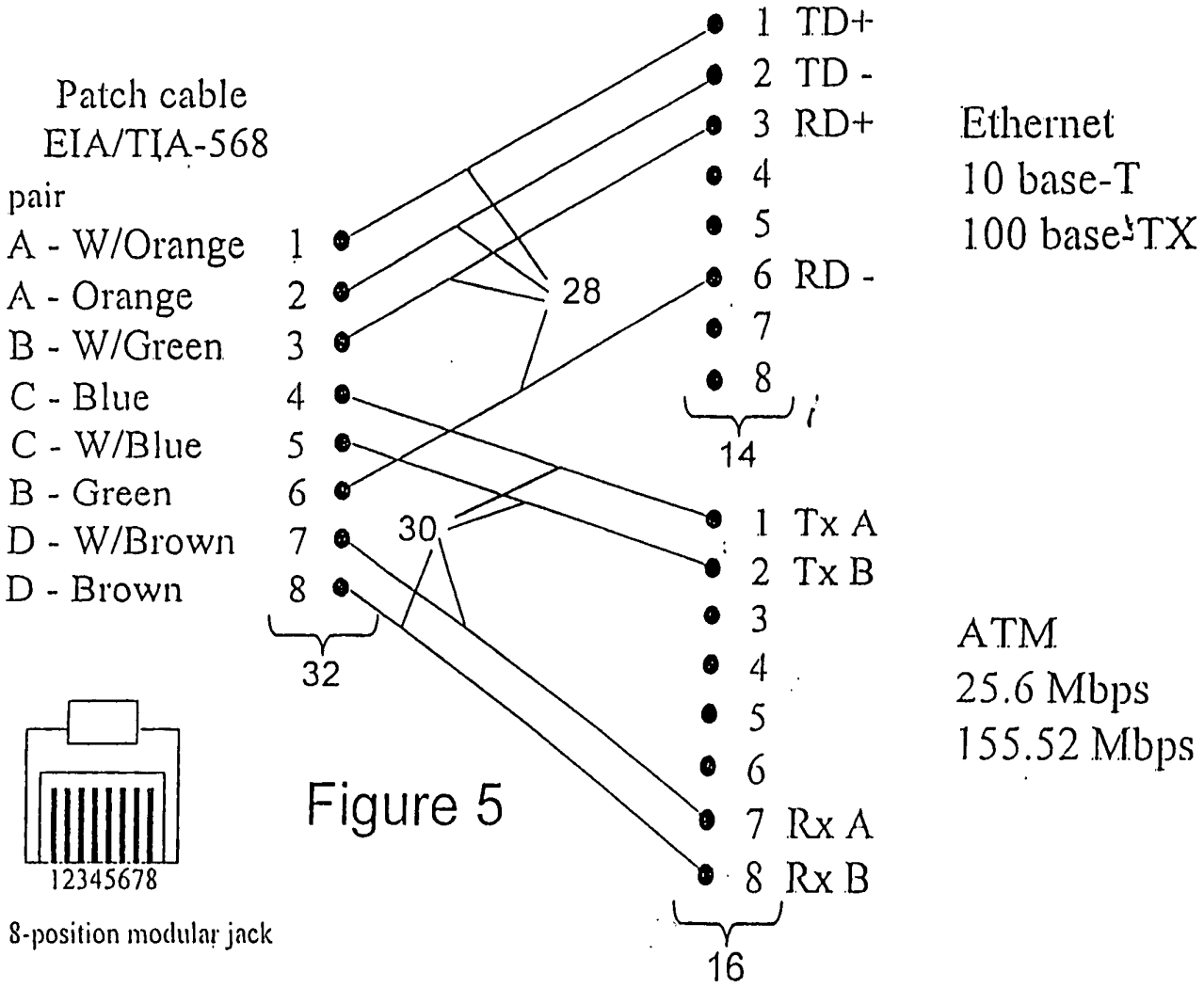


Figure 5

INTERNATIONAL SEARCH REPORT

Inter nal Application No
PCT/US 99/15626

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04L29/08 H04L12/44

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H04L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	NILSSON P ET AL: "ANX-HIGH-SPEED INTERNET ACCESS" ERICSSON REVIEW,SE,ERICSSON. STOCKHOLM, no. SPEC. INT. ISS, 1 January 1998 (1998-01-01), pages 24-31, XP000751712 ISSN: 0014-0171 abstract page 27, left-hand column, line 16 - line 47 page 27, middle column, line 24 -page 28, middle column, line 32 -/--	1-43

[X] Further documents are listed in the continuation of box C.

[ ] Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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Date of the actual completion of the international search	Date of mailing of the international search report
11 February 2000	24/02/2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Adkhis, F

Form PCT/ISA/210 (second sheet) (July 1992)

International Application No
PCT/US 99/15626

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	SAUNDERS S: "ECONOMICAL VIDEO NETWORK USES UNSHIELDED TWISTED-PAIR WIRING" DATA COMMUNICATIONS,US,MCGRAW HILL. NEW YORK, vol. 19, no. 10, 1 August 1990 (1990-08-01), pages 103-104, XP000137997 ISSN: 0363-6399 page 103, left-hand column, line 16 -middle column, line 3 page 103, left-hand column, line 38 - line 41 page 103, right-hand column, line 18 -page 104, left-hand column, line 7	1-43
A	JOHNS D A ET AL: "INTEGRATED CIRCUITS FOR DATA TRANSMISSION OVER TWISTED-PAIR CHANNELS" PROCEEDINGS OF THE IEEE CUSTOM INTEGRATED CIRCUITS CONFERENCE. (CICC),US,NEW YORK, IEEE, vol. CONF. 18, 1996, pages 5-12, XP000683279 ISBN: 0-7803-3118-4 abstract page 5, left-hand column, line 1 - line 16 page 11, left-hand column, line 26 - line 38	1-43

PC Access Using Two Twisted Pair Cables

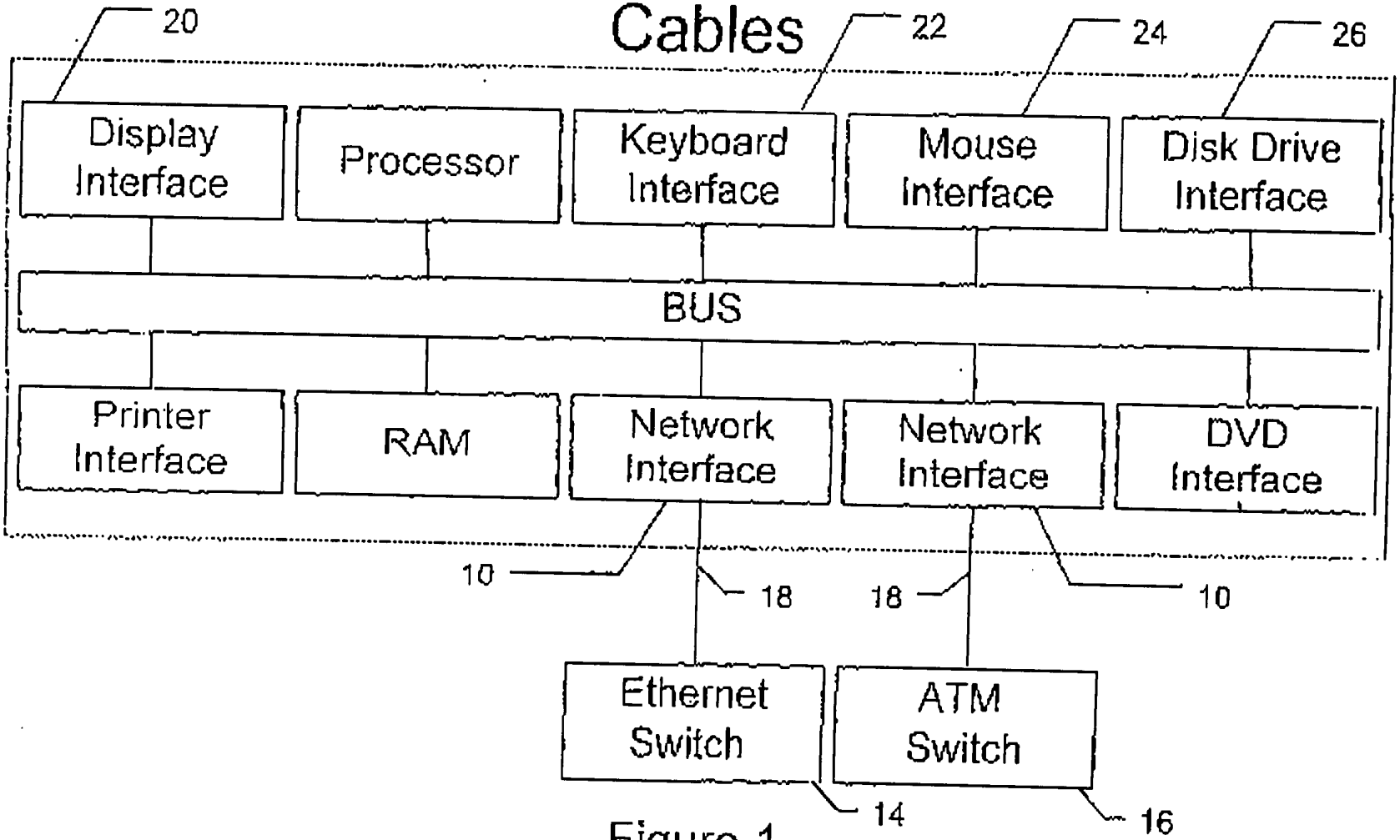
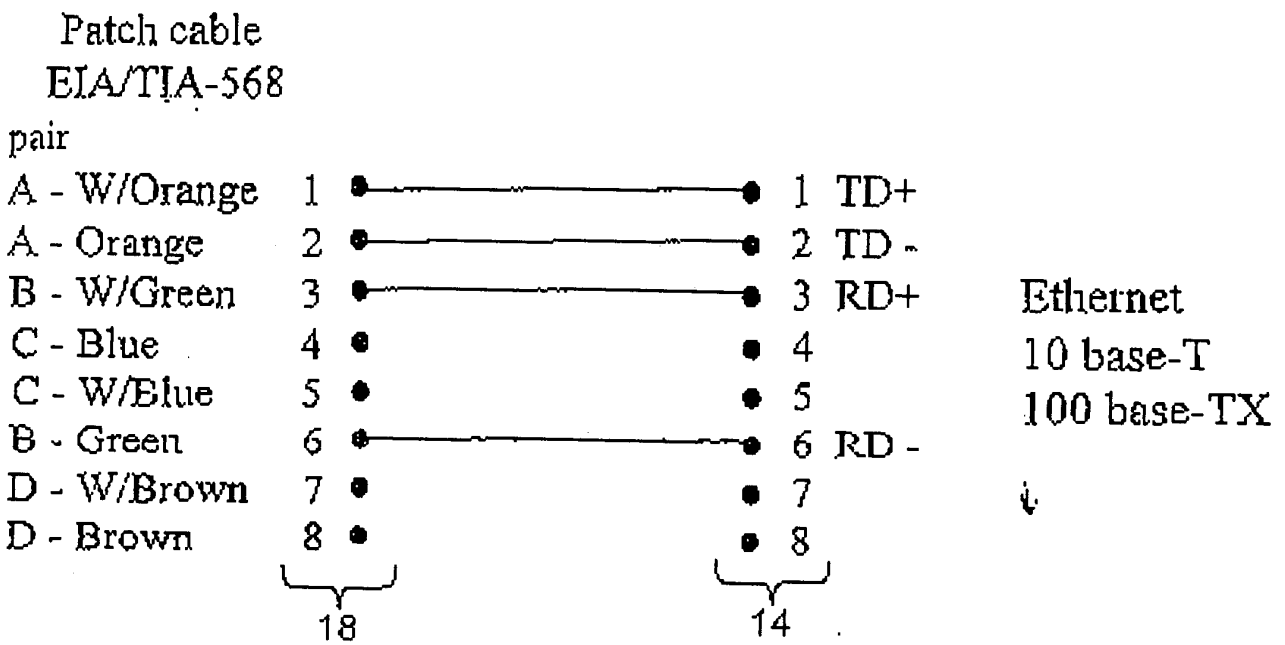
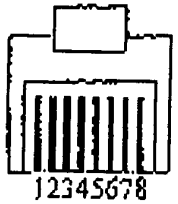


Figure 1
Prior Art

Schematic of Wiring for Ethernet Access

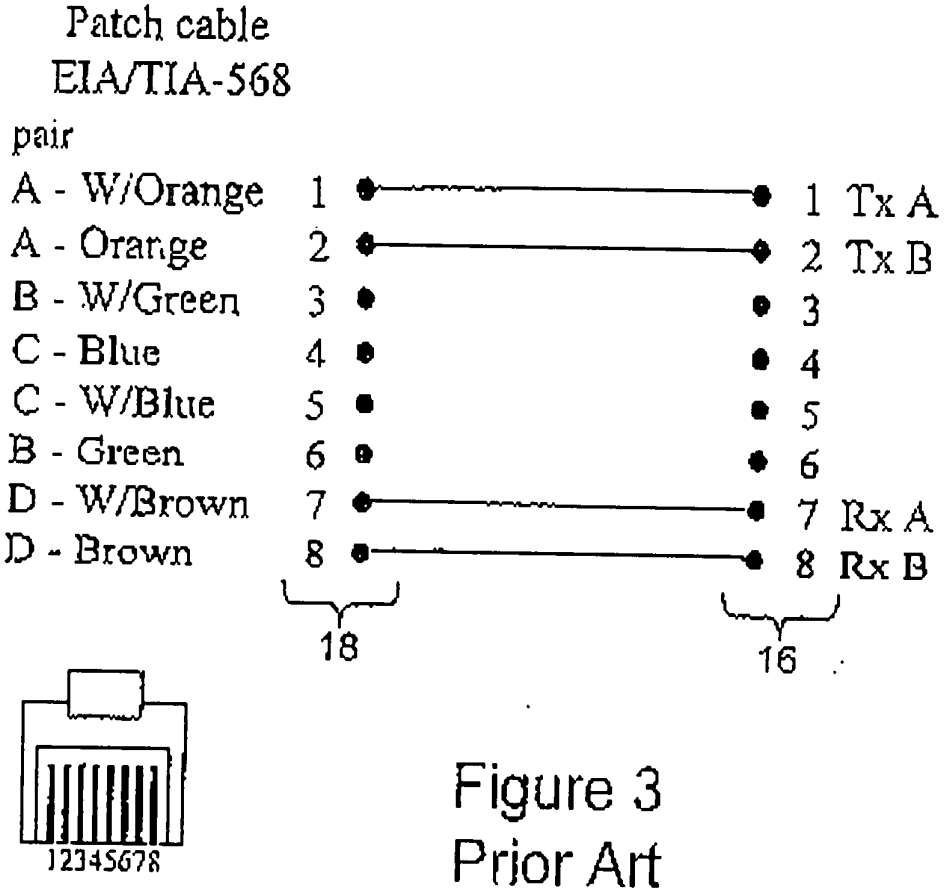




8-position modular jack

Figure 2
Prior Art

Schematic of Wiring for ATM Access



ATM
25.6 Mbps
155.52 Mbps

Figure 3
Prior Art

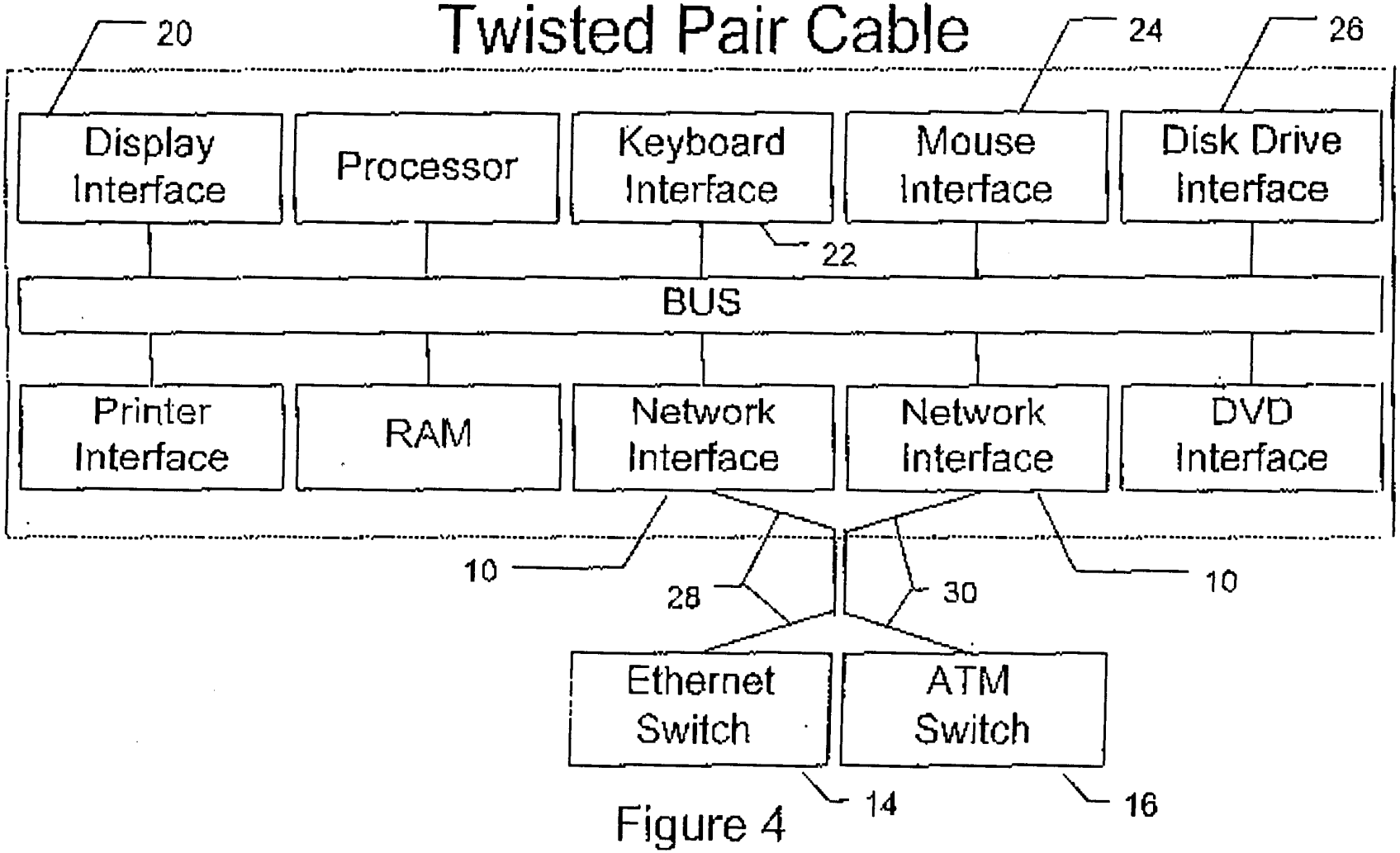


Figure 4

Schematic of Wiring for Concurrent Access Using a Single Twisted Pair Cable

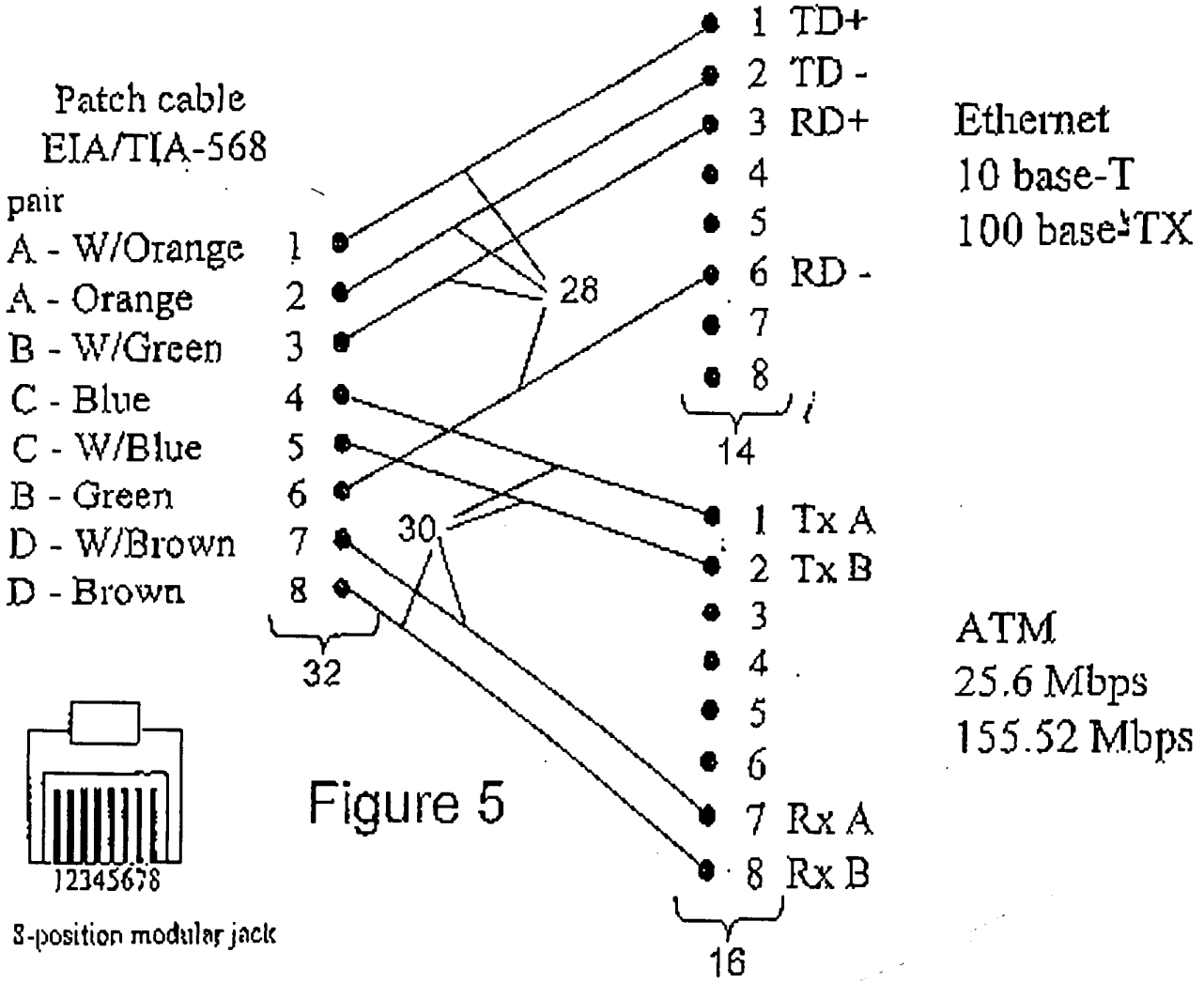


Figure 5